

ART. XI.—*Some remains of an extinct Kangaroo in the Dune-Rock of the Sorrento Peninsula, Victoria.*

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Port Phillip Bay is nearly closed to the south by two lines of sand dunes, of which the eastern is known, after the principal settlement upon it, as the Sorrento Peninsula.

The peninsula is formed entirely of sand dunes, which extend for twenty miles, from Point Nepean on the west, to Cape Schanck on the east. The dune belt is broadest at the east, where, with its associated alluvial deposits, it is seven miles in width.

The only direct stratigraphical evidence as to the age of the Sorrento dune series is that, near Cape Schanck, it abuts against the "older volcanic" basalts, which are certainly the earlier in age.

The thickness of the dune series is considerable. A dune known as St. Paul's rises 176 feet above the sea. West of Sorrento is another to which the Admiralty Chart assigns the height of 225 feet. At Fowler's Cove the highest dune is 130 feet.¹ Wells have been sunk to the depth of three or four feet below sea level, where a plentiful supply of water has rendered further sinking unnecessary. There is, therefore, no direct evidence as to the full thickness of the dune formation in the Sorrento Peninsula. The minimum is 360 feet; and the fact that the beaches on the sea front are formed of pebbles of the dune sandstones and limestones shows that no other rocks are exposed for some depth below low tide line.

Throughout the body of this thick mass of dune formation no determinable fossils have yet been recorded. They may have been abundant; but all the calcareous material has been

¹ This is the height as determined trigonometrically by Mr. Fowler; the Admiralty Chart gives it at 117 feet.

dissolved and redeposited as the dune limestones, or in concretions around plant roots.¹ M'Coy² has recorded the occurrence of the extinct species *Arctocephalus williamsi* M'Coy, and *Phascolumys pliocenus*, M'Coy, and of the living Tasmanian *Sarcophilus ursinus* (Harris), at Queenscliff, on the western side of Port Phillip entrance, in the "sandy beds intercalated with the Pliocene Tertiary limestone." These fossils probably came from the western dune series.³

The dune series is strongly falsebedded. The dominant false dip is to the north and north-east. This fact suggests that the dune material drifted from the south and south-west, and that what are now the southern cliffs were formed on the northern slope of the dunes. The drift of the sand at present is still eastward and north-eastward. The sand patch in front of Mr. Fowler's house has, he tells me, travelled eastward for 20 yards during the last fifteen years.

The limestones also have a general slope downward to the north, having been deposited along the natural drainage plains. That the stratification is due to false bedding is shown by the vertical position of most of the concretions in places where the bedding is inclined.

A typical section of the dune series is shown at Fowler's Cove. At the top are three feet of sand supported by thin horizontal layers of limestones; then follow five feet of sands with abundant stem and root concretions; the dip in this bed increases in the lower part. At the base are fifteen feet of strongly falsebedded sands, dipping as much as 30° to the north-east.

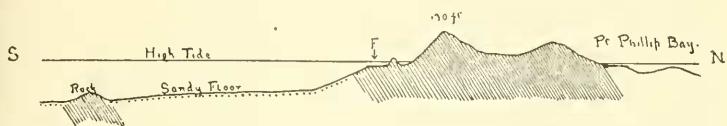
The existence of stacks of dune limestone along the foreshore also shows that marine denudation has pushed back the coast-line, and the dunes must at one time have extended some hundreds of yards further to the south than they do at present. This marine advance may have been due either to a subsidence of the land or a local rise in sea level; but a relatively greater elevation of the dune belt in recent geological times is almost certain.

¹ A description of these fossil-like cylindrical concretions has been recently given by Mr. T. S. Hall, *Vict. Nat.* (1901) p. 47.

² *Prod. Pal. Vict.*, dec. v. (1877) p. 8, and dec. vii. (1882) p. 12.

³ Fragments of fossils have been recorded from the Otway dunes by Mr. R. Etheridge, *Jnr.* "Observations on the Sand Dunes of the Coast of Victoria." *Trans. Roy. Soc. Vict.*, vol. xii. (1876), p. 3.

A transverse section across the dune belt showing the shore platform, and the position of the line of submerged rocks is given below. The fossil described in this note came from the position marked F.



In the absence of fossils we have only the scanty stratigraphical evidence as to the age of the dune series. On this ground Mr. Murray in his "Victoria. Geology and Physical Geography" (1895, p. 100), assigns the dunes to the "Post-Tertiary age, some of them being of comparatively ancient and others of quite recent date, or even now in process of formation." This conclusion is certainly correct for the later limit of the series; for aboriginal kitchen-middens are being buried by the dunes. These kitchen-middens consist of layers of shells, all of edible mollusca; the spiral gastropods have been broken at the mouth, so that the body could be extracted; the fractures are due to direct blows and not to abrasion; the shells, moreover, are embedded in a soil containing fragments of burnt wood and charcoal.

That the Sorrento dunes are therefore, in part, of recent date, admits of no doubt; but the age at which their formation began is uncertain. Hence the discovery of a vertebrate fossil in the lowest exposed part of the dune series is of interest.

This fossil was discovered independently by Mr. T. W. Fowler and Mr. C. S. Price in 1900. A broken tooth of it was extracted by Mr. T. S. Hall, and is now in the National Museum. The fossil was exposed at low tide on the surface of the shore platform at Fowler's Cove, about three miles from Sorrento. As the platform is being planed down by the surf, Mr. Fowler feared that the fossil would be destroyed and he kindly invited me to examine it with a view to securing it for the University collection. I accordingly visited the locality in March, 1901, with Mr. Fowler, Mr. D. Le Soeuf, and Mr. F. J. Spry. The speci-

men proved to be the remains of a kangaroo, for it included the characteristic innominate bone. Unfortunately the specimen was very incomplete. There was no trace of the skull, and the only relics of limbs was a broken femur. The rest of the fossil consisted of part of the vertebral column with the remains of about ten ribs, and fragment of a scapula. The bones were brittle and fragile, and they were imbedded in a hard, tough, sandy limestone. Owing to the limited time during which the fossil was exposed above the sea, its complete extraction would have been impossible, even had it been thought worth while to quarry out the whole of the five foot slab of limestone over which the bones were scattered.

Accordingly we devoted our attention to the pelvis, which was skilfully quarried out by Mr. Spry. We obtained also the best of the vertebrae, a fragment of a scapula, and some parts of ribs.

That the pelvis belongs to a kangaroo is obvious. The part shewn is the inner surface of the right innominate; most of the ilium is preserved, but the fore-end is broken off. The hinder-end of the ischium and nearly all the pubis are lost, but enough of the obturator foramen is shewn to enable its outline and size to be approximately determined. A photograph taken by Mr. Fowler some time before our visit showed most of the pectineal process and the outline of the proximal part of the pubis.

The following dimensions show the relative sizes of the fossil with the largest pelvis of *Macropus giganteus*, Zimm., in the University Biological Museum, and in the largest *Macropus* pelvis in the National Collection, which have been kindly shown me by Mr. T. S. Hall, and Mr. J. A. Kershaw, respectively.

	Fowler's Cove Fossil.	<i>Macropus giganteus</i> , Univ. Coll.	<i>Macropus</i> sp., Nat. Mus.	Owen's <i>Palorchestes</i>
From base of pec- tineal process to back of ilium -)	68 mm.	36 mm.	46 mm.	59 mm.
Thickness (dorso- ventral) of base of ilium - -)	48 mm.	23 mm.	29 mm.	47 mm.
Width of ischium opposite middle of obturator fora- men - - -)	54 mm.	24.5 mm.	30 mm.	50 mm.

It is therefore not probable that the fossil kangaroo is a *Macropus giganteus*. The Great Red Kangaroo (*M. rufus*, Desm.) is somewhat larger than the Great Grey Kangaroo. Lydekker gives the following measurements of the two species.¹

	<i>M. giganteus.</i>	<i>M. Rufus.</i>
Length of head and body	- 60 in.	- 65 in.
Length of tail	- 36 in.	- 42 in.

The large pelvis in the National Museum may belong to *M. rufus*. But these measurements, as well as those of the skeleton given by Owen, show that *M. rufus*, the largest of living kangaroos, was much smaller than the fossil.

We must, therefore, turn to the great extinct kangaroos for comparison with the Fowler's Cove fossil.

From the general resemblance of the pelvis to that of *Macropus giganteus* it is natural first to compare the specimen with *M. titan*, Owen. This species is admittedly a close ally of *M. giganteus* and it has been suggested may be only a variety thereof. Its size was not much greater than that of even *M. rufus*. Owen's figures and measurements show the relative sizes of the two species. Thus the width of the distal end of the femur is 72 mm. in *M. titan*,² and 62 mm. in *M. rufus*.³ Comparing the dentition, the length of the last molar in *M. rufus* is shewn by Owen's figure to be 15.5 mm.; that of *M. titan* is 27 mm. The length of the last four upper molars is 50 mm. in *M. rufus*,⁴ 59 mm. in *M. titan*.⁵ Hence *M. titan* did not exceed *M. rufus* by nearly as much as this fossil did.

Owen has figured⁶ part of an innominate, which he referred to *Palorchestes azael*. The measurements are given in the fourth column on p. 142. They show that the Fowler's Cove fossil is even larger than in the giant *Palorchestes*. The characters of the innominates however, so far as the data are comparable, agree so closely that they no doubt belong to the same species.

¹ Lydekker. Handbook to the Marsupialia and Monotremata (1896), pp. 15, 23.

² Owen. On the Fossil Mammals of Australia, pt. x. Phil. Trans. vol. clxvi. (1876), pl. xxvii.

³ *Ibid.*, p. 203.

⁴ Owen. On the Fossil Mammals of Australia, pt. viii. Phil. Trans., vol. clxiv. (1874), pl. xxi. fig. 2.

⁵ *Ibid.*, pl. xxi., fig. 1.

⁶ Owen, *op. cit.* (1876), pl. xxii.

But what name should be given to the species is a little doubtful. Owen unhesitatingly referred his innominate, which came from the Darling Downs, Queensland, to *Palorchestes azael*. But Lydekker in his "Catalogue of the Fossil Mammalia in the British Museum,"¹ has declined to accept Owen's specific, or even generic determination of the great series of Macropodid bones in that collection. He says there is no reason why they should be placed in one genus more than in another. *Palorchestes* was founded on the characters of the skull, and at present there is no evidence to correlate scattered skeleton bones, except their size. Mr. Oldfield Thomas remarked during a discussion at the Zoological Society that he found dimensions one of the most useful characters in the identification of mammals. Hence there is no reason to doubt that Owen was right in assigning his innominate to *Palorchestes* rather than to *Macropus*, but as he has himself² remarked some species of *Procoptodon* eg., *P. goliah* (Owen) rivalled *Palorchestes* in bulk; hence size alone will not help us to separate these two genera.

The only evidence on this point is that of the teeth. A broken tooth of the Fowler's Cove specimen was collected by Mr. Hall and is now in the National Museum. Mr. Hall has identified it, no doubt correctly, as a piece of lower incisor. It is 34 mm. long, 16 mm. broad, and 7 mm. thick. In *Procoptodon* the lower incisors are subcylindrical. They have, says Owen, "a full elliptic section;" the diameters of the transverse section, according to Owen's measurements, are 6 lines (12.75 mm.) vertically, and 5 lines transversely. In *Palorchestes* on the other hand the lower incisors are spatulate. Hence the evidence of this tooth shows that the fossil cannot be a *Procoptodon*. It is, therefore, in all probability, a *Palorchestes azael*, and justifies Owen's identification of the innominate figured by him in 1876.

Accordingly the lower exposed part of the Sorrento dunes dates back to the time of the extinct giant kangaroos, the age of which is described as late Pliocene or lower Pleistocene.

¹ Pt. v. (1887), p. 239.

² Owen, *op. cit.*, pt. ix. Phil. Trans., vol. clxiv. (1874), p. 800.